**Objectives**

Upon completion of this activity, you will be able to:

* Identify positive and negative feedback systems
* Describe how feedback systems impact global climate change

**Causal Principles**

1. Gravitational energy, thermal energy and/or chemical **energy** drive all movement and change of matter on Earth.

2. A system is in **equilibrium** when energy in the system is balanced.

3. Matter moves and changes to return a system to **equilibrium.**

8. **Feedback loops** can accelerate, decelerate, or dampen change.

**PART 1: Background Notes**

**Part 2: Group Work – Read the questions and complete them along with the diagrams.**

A. On the diagram, label the steps that illustrate the positive feedback loop between global warming and permafrost.



B. On the diagram below, draw how increasing temperature and therefore water vapor in the atmosphere can lead to both negative and positive feedback loops.

**Questions**

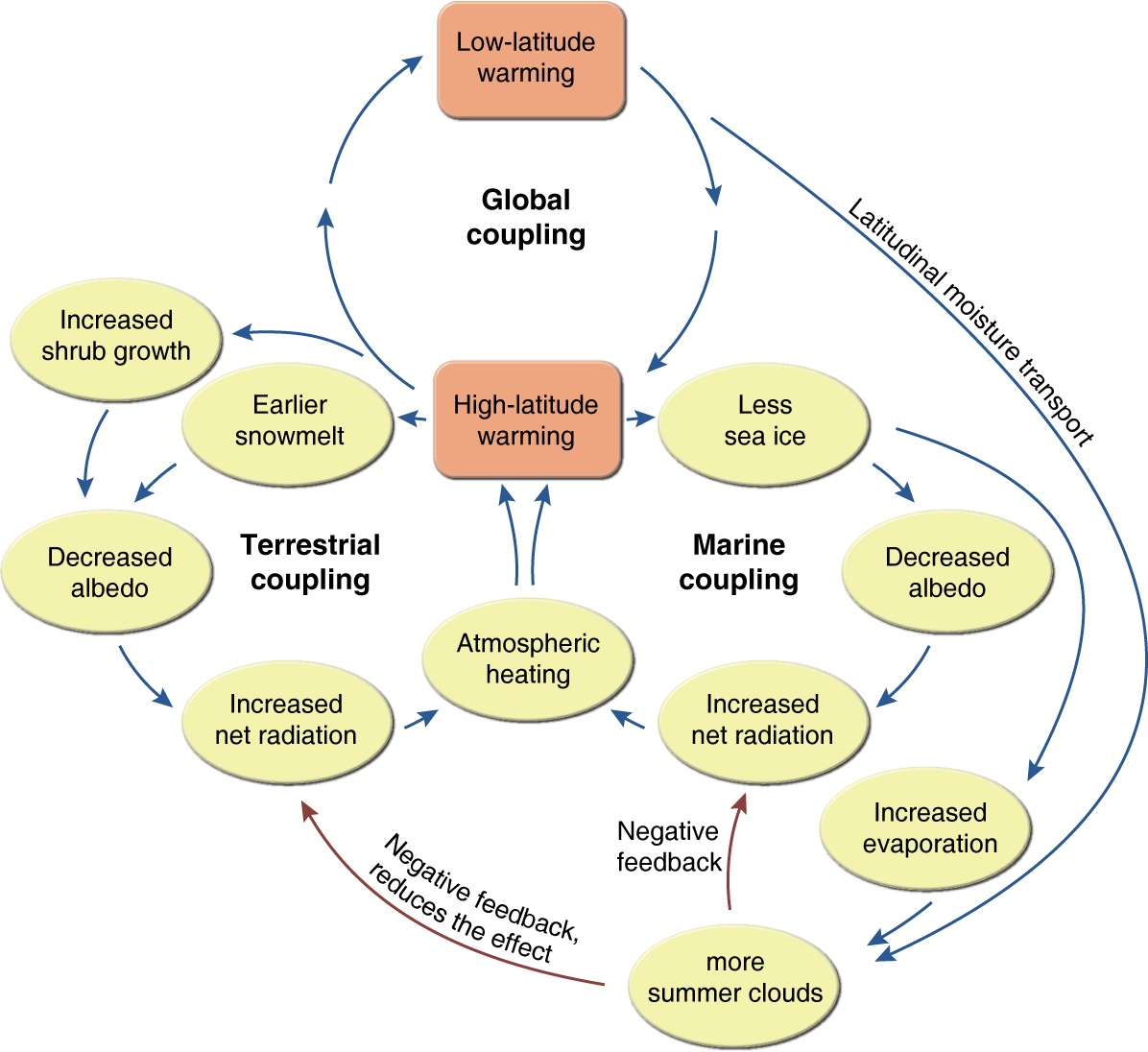
**Albedo:**

On Earth, water and soil covered surfaces absorb the Sun’s radiation and convert it to thermal energy. Glaciers, ice sheets, and cloud reflect the Sun’s radiation, rather than absorbing it. During times when Earth’s surface is covered with more ice, more of the Sun’s radiation gets reflected back to space. During times of less ice coverage, more of the Sun’s radiation gets absorbed by the Earth’s surface and is converted to thermal energy. This thermal energy is radiated towards the atmosphere and absorbed by greenhouse gases.

1. Why is the permafrost / global warming cycle considered a positive feedback loop?
2. Explain how increasing temperature and therefore water vapor in the atmosphere can lead to both negative and positive feedback loops.
3. Use the principles in the introduction to label the underlying cause for the changes in each feedback system. Label BOTH diagrams.
4. If global warming causes the loss of glaciers and ice sheets, would this result in a negative or positive feedback loop? Explain your response.

On the diagram below, label the negative and positive feedback loops.

\*\*EDIT and remove negative label \*\*

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<http://www.unep.org/geo/ice_snow>

1. Pick a negative feedback loop and explain how it brings the system closer to equilibrium.

1. Pick a positive feedback loop and explain how it moves the system away from equilibrium.

**Part 3: Homework**

If you complete the group work, you may work on the homework **on your own.** This means your answers should be generally unique from other students’ answers. **Submit your homework using ANGEL**.

The following mechanisms have caused the climate to change in the past.

1. Determine if these will cause **global warming, cooling,** or **neither**, and explain **why.**
2. Determine whether these are examples of **positive or negative feedback loops** for the climate system.

**Aerosols**

Large volcanic eruptions can eject ash in the upper atmosphere. This ash can remain in the upper atmosphere for many months, blocking the incoming solar radiation.

**Rainforest**

Cutting down large portions of the forests on Earth kills living plants that remove CO2 from the atmosphere through respiration.

**Permafrost**

Melting of permafrost will release methane gas, a greenhouse gas.